CLAIMS

1. A plane detection apparatus for detecting planes from three-dimensional distance data, the apparatus comprising:

a line fitting means for fitting a line to each group of distance data points estimated to be in one plane in a three-dimensional space; and

a planar region growing means for extracting a plurality of lines estimated to be in one plane from a group of lines extracted by the line fitting means to calculate a plane from the plurality of lines,

the line fitting means fitting lines adaptively to the distribution of distance data points.

2. The apparatus according to claim 1, wherein the line fitting means extracts a group of distance data points estimated to be in one plane on the basis of the distance between the distance data points, and re-estimates, based on the distribution of the distance data points in the distance data point group, whether the distance data point group exists in one plane.

3. The apparatus according to claim 1, wherein the line fitting means extracts lines from a group of distance data points estimated to be in the one plane, takes, as a point of interest, a distance data point whose distance to the lines is largest in the group of distance data points, judges, when the distance is smaller than a predetermined threshold, whether the distance data points in the distance data point group are unevenly distributed, and segments the distance data point group by the

point of interest when the distribution is uneven.

4. The apparatus according to claim 1, wherein the line fitting means extracts a first line from the group of distance data points estimated to lie in the one plane, takes a distance data point in the group, whose distance from the first line is longest, as a point of interest, extracts a second line from the distance data point group when the distance is smaller than a predetermined threshold, judges whether a larger number of distance data points than a predetermined number exist continuously at one side of the second line, and divides the distance data point group by the point of interest when a larger number of distance data points than the predetermined number exist continuously.

5. The apparatus according to claim 4, wherein the line fitting means segments the distance data point group when the standard deviation of the distance data point group from which the first line has been determined is larger than a predetermined threshold.

6. The apparatus according to claim 1, wherein the planar region grouping means selects more than one line estimated to be in one plane and calculates a reference plane, searches lines estimated to be in the plane in which the reference plane lies as grouping lines from the group of lines, updates the reference plane with the grouping lines, repeats the grouping of the region of the reference plane, and outputs the updated plane as an updated one.

7. The apparatus according to claim 6, further comprising a plane recalculating

means for recalculating a plane from the group of distance data points except for ones whose distance from the updated plane is larger than a predetermined threshold, if any, existing in the distance data point group in the updated plane.

8. The apparatus according to claim 6, wherein the planar region grouping means estimates, based on a difference between a lines-determined plane and reference plane, whether the lines lie coplanar with the reference plane.

9. The apparatus according to claim 4, wherein the line fitting means generates the second line by the least-squares method from a group of distance data points estimated to be in the one plane.

10. The apparatus according to claim 1, wherein the line fitting means extracts lines on the basis of three-dimensional distance data measured by a distance measuring means which measures a distance on the basis of a parallax of two imaging means.

11. The apparatus according to claim 1, wherein the line fitting means extracts lines on the basis of three-dimensional distance data measured by a laser range finder.

12. A plane detection method of detecting planes from three-dimensional distance data, the method comprising:

a line fitting step of fitting a line to each group of distance data points estimated to be in one plane in a three-dimensional space; and

a planar region growing step of extracting a plurality of lines estimated to be

in one plane from a group of lines extracted by the line fitting means to calculate a plane from the plurality of lines,

in the line fitting step, lines being fitted adaptively to the distribution of distance data points.

13. The method according to claim 12, wherein in the line fitting step, there is extracted a group of distance data points estimated to be in one plane on the basis of the distance between the distance data points, and it is re-estimated, based on the distribution of the distance data points in the distance data point group, whether the distance data point group exists in one plane.

14. The method according to claim 13, wherein in the line fitting step, there are extracted lines from a group of distance data points estimated to be in the one plane, takes, as a point of interest, a distance data point whose distance to the lines is largest in the group of distance data points, it is judged, when the distance is smaller than a predetermined threshold, whether the distance data points in the distance data point group are unevenly distributed, and the distance data point group is segmented by the point of interest when the distribution is uneven.

15. The method according to claim 13, wherein in the line fitting step, there is extracted a first line from the group of distance data points estimated to lie in the one plane, a distance data point in the group, whose distance from the first line is longest, is taken as a point of interest, there is extracted a second line from the distance data point group when the distance is smaller than a predetermined

threshold, it is judged whether a larger number of distance data points than a predetermined number exist continuously at one side of the second line, and the distance data point group is segmented by the point of interest when the larger number of distance data points than the predetermined number exist continuously.

16. The method according to claim 12, wherein in the planar region grouping step, there are selected more than one line estimated to be in one plane and a reference plane is calculated, there are searched lines estimated to be in the plane in which the reference plane lies as grouping lines from the group of lines, the reference plane with the grouping lines is updated and the grouping of the region of the reference plane is repeated, and the updated plane is outputted as an updated one.

17. The method according to claim 16, further comprising a plane recalculating step of recalculating a plane from the group of distance data points except for ones whose distance from the updated plane is larger than a predetermined threshold, if any, existing in the distance data point group in the updated plane.

18. The method according to claim 16, wherein in the planar region grouping step, it is estimated, based on a difference between a lines-determined plane and reference plane, whether the lines lie coplanar with the reference plane.

19. An autonomous locomotion robot apparatus, comprising:

a distance measuring means for acquiring three-dimensional distance data;

a plane detection apparatus for detecting a plane from the three-dimensional

distance data; and

a motion controlling means for controlling the motion of the apparatus on the basis of the result of plane detection by the plane detection apparatus,

the plane detection apparatus including:

a line fitting means for fitting a line to each group of distance data points estimated to be in one plane in a three-dimensional space; and

a planar region growing means for extracting a plurality of lines estimated to be in one plane from a group of lines extracted by the line fitting means to calculate a plane from the plurality of lines,

the line fitting means fitting lines adaptively to the distribution of distance data points.

20. The apparatus according to claim 19, further comprising a texture imparting means for imparting a texture to an object.

21. The apparatus according to claim 20, wherein the texture imparting means projects a texture to the object when acquiring the three-dimensional distance data.